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Water and vertical territory: the volatile and hidden historical geographies of Derbyshire's lead mining soughs, 1650s–1830s

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ABSTRACT

This paper is concerned with the complex subterranean politics of lead mining in the Derbyshire Peak District. We focus specifically on the implications of lead mining 'soughs' – underground channels driven to drain water out of mines to allow for mineral extraction. Built during the 17th, 18th and 19th centuries, soughs were substantial, capital and labour intensive projects which served a key function in the refashioning of subterranean and surface hydrological landscapes. They were 'driven' at a time when water was both a major hindrance to mining endeavour and the primary energy source for industrial expansion, such that historical disputes surrounding sough drainage were common. Here, we draw on unpublished historical legal records to explore the ways in which vertical conceptualisations of space were central to the legal discourse over soughs and extend the so called 'vertical turn' in geography to include subterranean proto-historical landscapes. Drawing on a high profile conflict between English entrepreneur Richard Arkwright and Conservative politician Francis Hurt, we go some way to addressing recent claims for more ethnographic detail in studies of verticality by considering the people who legally and physically negotiated sough development below as well as above ground. We also illustrate the range of temporalities which framed sough developments and highlight the cross-generational nature of the legal disputes over soughs and the productive landscapes they drained.

Introduction

A series of scholarly interventions in recent years has made the case for considering the vertical dimension of landscape (Scott 2008). This work has highlighted the value of looking through rather than across landscapes (Graham 2004, Graham and Hewitt 2013; Elden 2013) and for adopting more multidimensional, volumetric consideration of space (Elden 2013; see also Bridge 2013; Adey 2013). Much of this work, however, as Elden notes, 'has been oriented up, even if looking down' (Elden 2013, 6). Taking a lead from

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Weizman's 'politics of verticality project' (Weizman 2002, 2003, 2007), for example, there has been a growing body of scholarship with an aerial focus (Adey 2010), and particularly in the fields of critical urban geography (Graham 2010; Graham and Hewitt 2013; Kaika and Swyngedouw 2000) and critical geopolitics (Gregory 2011; Adey 2010). Yet the verticality of social, economic and political relations and processes below the ground also requires more sustained critical engagement (Forsyth et al. 2013). Existing work in this genre has focused on governance of the subterranean in a colonial context (Scott 2008; Braun 2000, Piper 2007, Pike 2005) and on the underground dimension of specifically urban landscapes (Pike 2005; Edensor 2005). There is also a long-standing literature on mining and exploitation of oil and gas reserves, and the way in which mining reworks local topography, drainage systems, land use and vegetation patterns 'giving rise to new structures and new meanings to the landscape' (Bridge 2004, 209; see also Bridge 2009, 2013). As Bridge has highlighted, however, the underground cultural landscape sits at the 'nexus of history, politics and culture, the focal point of a contested moral landscape', and represents, as a result, an area ripe for historical investigation (Bridge 2004, 242). 'The fundamental unfamiliarity' of underground landscapes makes them at once places of exploration (Elden 2013, 9) and 'morally uncertain spaces, places in which codes of conduct are not yet settled and over which different groups make competing claims' (Bridge 2004, 242). In this paper, we are concerned with the hidden, uncertain and contentious subterranean landscapes of lead mining in Derbyshire (Figure 1) and the complex politics that surround them. Specifically, we explore the implications of lead mining 'soughs' – underground channels driven to drain water out of mines to allow for mineral extraction.[1] Built in the seventeenth, eighteenth and nineteenth centuries, soughs were substantial, capital- and labour-expensive projects (Willies 1986). They were technologically innovative, representing understated tributes to the engineering skill and geological knowledge of the sough engineers and sough drivers (often miners) who constructed them (James 1997; Rieuwerts 1984; 2007).

Soughs remain important elements of Britain's rich industrial heritage (Barnatt et al. 2013). Beyond a substantial body of work on soughs by mining engineers, caving and mine enthusiasts,[2] however, there has been limited research undertaken on the topological and topographical implications of soughs from a geographical perspective and no work on the contribution that a study of soughs could make to contemporary debates about verticality and volumetric conceptualisations of space and power.

We show how soughs can be considered central to the creation of Braun's 'vertical territory' within early modern Britain – a territory that subsequently became contested precisely because of the way it was created (Braun 2000). By drawing attention to proto-industrial landscapes as sites of underground 'expansionism, insurgency and social negotiation', we

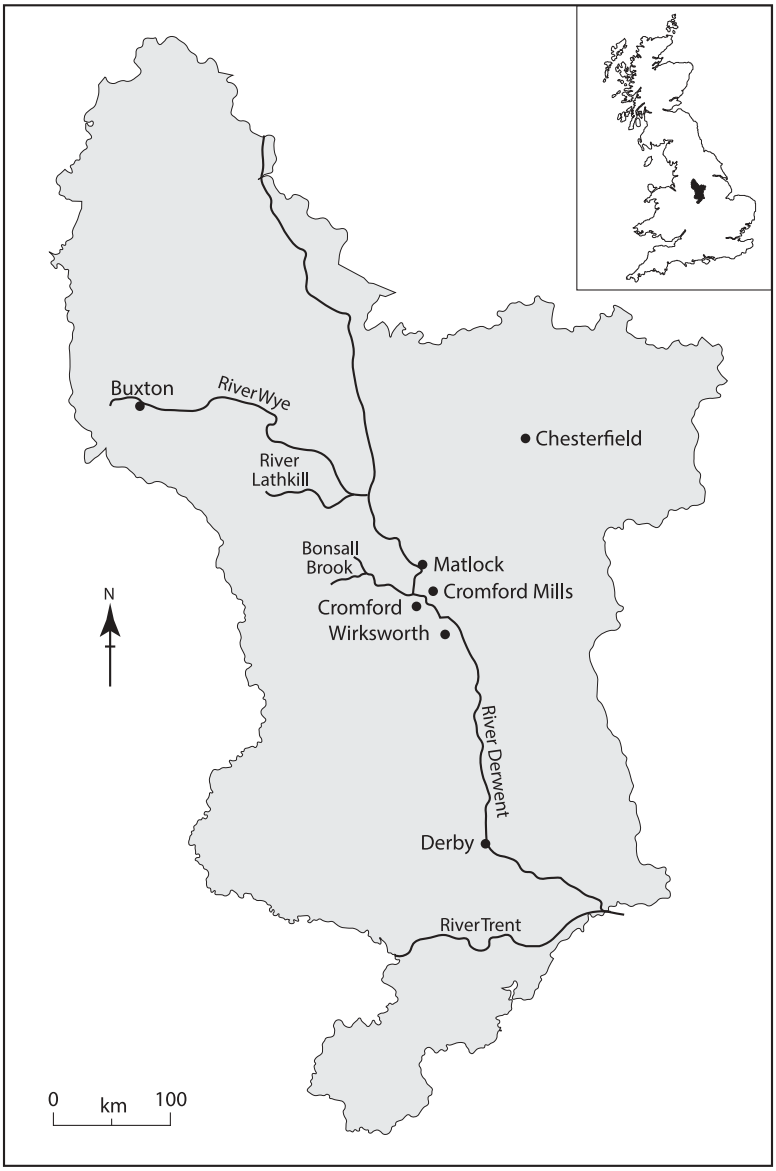

Figure 1. Map of Derbyshire, showing the Derwent Valley, Bonsall Brook and the location of Cromford and Wirksworth.

contribute to and extend scholarship on the vertical turn in geography to include an historical perspective (Garrett 2016). The paper demonstrates how vertical (and also volumetric) conceptualisations of space were central to the legal discourse over soughs, illustrating how struggles above the surface extended into the subterranean (Elden 2013, 14), and we consider soughs as spaces through which to examine both the hydrological changes and legal disputes that resulted from the drainage of the lead mining landscapes, highlighting in Garrett's terms how 'multiple places could be

within one space' (Garrett 2016). We address Harris' call, albeit made with respect to vertical urbanisms, to 'emphasize more everyday verticalities and disrupt top-down analytical perspectives' (Harris 2015). We draw attention to ethnographic detail by considering the people who legally and physically negotiated sough development below as well as above ground and specifically making use of the documented oral testimonies and 'voices' of those involved in mineral extraction and sough driving. Throughout the paper, we illustrate the range of temporalities which framed sough developments, associated with changing flows of water underground over time, the waxing and waning of sough developments depending on changing economic, political and social configurations and the cross-generational nature of the legal disputes which were raised over soughs and the productive landscapes they drained. It is first useful, however, to briefly outline the history of sough driving in the lead mining districts of Derbyshire.

Lead mining, Soughs, Water and Legal Conflict in the Derbyshire Peak District

There is a long history of lead ore mining in Derbyshire dating back to the Roman times (Barnatt et al. 2013; Slack 2000). Ore was traditionally found by following veins from surface outcroppings, particularly in 'rakes' or vertical fissures (Slack 2000), and since the early Middle Ages the Derbyshire miners had exercised the rights to dig for lead ore on any land, regardless of ownership. By the 1600s, free mining rights meant lead mining could take place anywhere, with the exception of certain places such as churchyards, orchards and roads, within the so-called 'King's Field', that is to say land which lay within the Crown's Duchy of Lancaster. The King's Field was overseen by the Barmaster, a post normally rented to a local gentleman or aristocrat by the Crown (Wood 1993), whose role was to collect lead ore duties, which could be substantial.[3] Anyone, however, who could demonstrate to the Barmaster that he had discovered a new vein, was allowed to open a mine and retain the title to it as a 'meer' or small block of ground along a mineral vein, as long as he continued to work it and, significantly, mining took precedence over land ownership.[4] As a result, and needing little capital investment, at least for mining of ores located at or near the surface, there emerged hundreds of small mines which were worked across the region.

By the 1600s, lead had become second in importance to the national economy only to wool (Willies 1986; Slack 2000). There was increasing demand from both the domestic and international markets, coincident with rising prices for lead, and technological and organizational developments which facilitated extraction and transportation of ore (Wood 1993, 1999). As Wood notes, 'Thousands of people moved into the area in search of new work opportunities' (Wood 1997). Even as early as the first decades of the

seventeenth century, however, many mines in the Derbyshire area had been worked down well below the surface and to ground water level (Slack 2000, 24).

Drainage of the lead mine was essential if new sources of ore were to be reached (James 1997). Previous attempts to 'unwater' the mines using surface or underground waterwheels, horse-powered pumps or 'engines' had largely been unsuccessful (Rieuwerts 1987; James 1997). The use of soughs from the later seventeenth century, however, fostered the ability to exploit ever deeper veins. Soughs in effect represented a form of 'gravity drainage', an underground, horizontal channel that was driven from relatively low points in river valleys to drain mines that were often several kilometres away, and allowed access to otherwise flooded veins. In as much, soughs transformed the Derbyshire lead mining industry such that it 'reached new heights' or, as it were, depths (Slack 2000, 41). Through unwatering, these hitherto inaccessible subterranean landscapes were transformed from non-human to human spaces, so becoming unnatural spaces of technological innovation and intervention (Williams 1990, 4). At the same time, they also became cultural landscapes characterised by unique laws and economic opportunities, which built on and extended existing lead mining customs, through their unique attributes of being driven through 'barren' soil, rather than following a vein. They were, therefore, at once frontiers of human ingenuity and spaces of risk, hope and subterfuge.

The first mining sough in England was constructed in the 1630s to drain the rich Dovegang (or Gang) mineral veins.[5] This endeavour was not without controversy and the story of the seizure of the Dovegang mines by the then attorney general, Sir Robert Heath, and his dispossession of local miners of their free-mining rights, has been discussed elsewhere (Kirkham 1953, Dias 1981, Slack 1993, 1994; see also Wolley Manuscripts). The draining of the mines per se, however, was engineered by Sir Cornelius Vermuyden, famous (and knighted) for his draining of England's fenlands. Despite 'attracting quarrels and lawsuits' throughout the sough's development, his endeavours had effectively laid dry the mines in the Cromford Moor area by 1651 (Slack 1993, 45).

The potential to drain water to access deeper mines and the rewards that could be reaped, stimulated an increase in sough driving throughout the late seventeenth and eighteenth centuries, and over the following 200 years, soughs of varying sizes were constructed all over the Derbyshire orefield, producing a network of in excess of about 400 individual soughs across the region by the late nineteenth century (Rieuwerts 2007). As well as spreading over this area, soughs extended vertically. Once a sough-drained mine was worked down to the new water level, the need for a new, deeper sough arose, and over time in the richest orefields, including Dovegang, ever deeper channels were driven below earlier ones to provide deeper drainage to the mines. As Oakman notes, 'The higher the sough, the less the effect … the

deeper the sough the more effective it was in draining the reservoir of water. Each time a deeper sough was made, the smaller the reservoir became' (Oakman 1980). As a result, some soughs were several hundred meters below ground, cutting through vertical space, albeit over extended periods of time.

With new sources of ore now in reach through sough ventures, Britain had become Europe's largest producer of lead by 1800, with the Derbyshire mines dominating production with an output that peaked at about 10,000 tonnes of metal per year. The lead industry, however, was highly litigious. It had traditionally been governed by a strict set of rules and regulations and mining customs, which were in turn based upon precedent and common usage (Raistrick and Jennings 1965, 115).[6] There were disputes between miners and landowners over possession of mines and over payment of duties, conflicts between separate soughs draining the same area, as well as those between mine and sough owners. Indeed, 'in all of the mining communities, conflict occurred over the extent and nature of the "libertie of free searching"' (Manlove 1851), intensified by the profits to be made from the expansion or ore mining as wealthy entrepreneurs attempted to 'rationalise' or marginalise ancient customs which were perceived as barriers to economic growth (Wood 1993, 35). As Wood has shown, 'the denial of commons or the restriction or abolition of customary entitlements implied more than simply the loss of access to land, food, pasture, minerals, or to shorter or more flexible working hours. The economics of custom were intimately bound up with senses of community and self' (Wood 1997, 51–52). Erosion or challenges to custom thus had far-reaching implications.

Soughs added to this historical, political and cultural complexity of the underground landscape (Wittfogel 1956; Cosgrove and Petts 1990; Matless 1992; Cosgrove, Roscoe and Rycroft 1996; Swyngedouw 1997, 2004). They began to be 'driven' at a time when incipient scientific geological knowledge provided a new way of envisioning landscape (Scott 2008, 1859) and when water was both a major hindrance to mining endeavour and yet was the primary energy source for industrial expansion such that historical disputes surrounding sough drainage were common. Disputes over the implications of soughs, however, brought into relief a broader set of complex, historical mineral rights and customs while simultaneously fostering the development of legal precedents and benchmarks which would be cross-referenced and recalled in different sough-related conflicts over different periods of time.

A number of particularly high-profile examples of disputes reveal the material multidimensionality and legal complexity of sough disputes in detail. One such example, between industrialists Sir Richard Arkwright, Sir Francis Hurt and their descendants, is the subject of the following section. We draw on primary research, based on materials held at a variety of local, county and national archives, to examine early industrial water conflicts

involving these key figures and several soughs that connected the Wirksworth orefield with the River Derwent.[7] The archives reveal how the Arkwright family's negotiations over access to water supply to turn their textile mills at Cromford would not have been possible without various inter- and intra-sough factions that created and recreated the underground landscape of mining and mine drainage through successive generations. We analyse and connect the dialogues and transformations that took place underground, within the earth, with those that took place at the surface, reinforcing the importance of thinking vertically and stratigraphically about space in this context and highlighting the importance of juxtaposing different layers and levels within the vertical frame. Given that, as Wood has noted, 'the Derbyshire miners of the mid-17th century appear to have lived in a culture which was essentially oral' (Wood 1993, 35), we also highlight the importance of oral testimony in legal conflicts over subterranean conflictual spaces, providing a bottom-up texture to the negotiations over underground territory and going some way to addressing Harris's recent call for more 'ethnographic detail' in discussions of 'vertical life' (Harris 1993).

Unearthing a Sough Dispute: Richard Arkwright, Water, and Mine Drainage, 1771–1807

Sir Richard Arkwright, of cotton-spinning fame (Fitton 1989), came to Cromford, Derbyshire, in 1771 for two key reasons: the availability of wage labour and water power. The local mining industry attracted migratory labouring classes, ensuring a readily available, cheap workforce which could be employed in the new factory system, and the off-flow of the rivers of Peak District provided the type of water required to power what would become the first large waterwheel-driven cotton mills (Wood 1999). Cromford Sough had originally been constructed in the late 1650s to unwater the rich Dovegang-Godber mineral complex in the Wirksworth-Cromford area but had been significantly extended in the eighteenth century.[8] By this time, its outflow provided several advantages: the discharge was substantial and the water issued at a fairly constant quantity and temperature, meaning it was unlikely to freeze over in winter months (Ford and Rieuwerts 2000). Indeed, Arkwright's first mill at Cromford initially solely depended on the water issuing from the sough, while a second mill was built in 1776 that made use of the combined flow of Cromford Sough and Bonsall Brook.[9] The importance of the sough water to Arkwright's operations is evident from a 1791 calculation that stated that the average flow from the sough was 71.5 tons of water a minute, whereas the Bonsall Brook only contributed five and three fifths (Cooper 1983, 69–70).

Arkwright, though an undeniably powerful figure in Britain's industrial history, was no stranger to the law courts. He was accused of 'some very devious behaviour towards his partners' throughout his industrial career and

was involved in several trials challenging his spinning patent (Fara 2011, 46–47). Exercising his rights to 'divert, turn and carry' water, Arkwright also modified most of the water courses around Cromford to better service his mills. His diversion of the Bonsall Brook for the benefit of his second mill, for example, caused the water to run over the road from between the communities of Cromford and Crich, impeding the free passage of foot travellers. Challenged by the overseer of the highway, Arkwright stated that he 'would turn the water as often as he pleased'.[10] Arkwright's alterations to existing water flows above ground also brought him into conflict with the owners of Cromford Sough. Legal documents compiled on 3 June 1785 state that 'Richard Arkwright has found it necessary that the water coming out of the sough should be conveyed to the mills at a higher level'.[11] In addition, the owners of the sough were prevented from going inside to inspect and repair it, and as the sough had collapsed in places, the water had been dammed up into several of the lead mines that used to be unwatered by the sough. The case was settled out of court and ultimately Arkwright's diversion was sanctioned though not before he had agreed to pay the owners substantial damages.[12]

Arkwright's presumptuous use of local water, typified by this dispute, was challenged by the construction of a later, more ambitious sough venture. The Meerbrook Sough was planned at 'the lowest practicable contour capable of offering gravity drainage to the Wirksworth mining field' (Rieuwerts 2007, 40). running 14 fathoms deeper than the Cromford Sough and thus allowing ore extraction of the deeper mineral veins of the rich Dovegang-Godber complex.-[13] The development was celebrated as offering promise and profit in the future. As mine agent William Frost stated in 1838, 'The progress of the sough has all my life been looked forward to by the miners, as what would be of the greatest benefit to the mines'.[14] This undertaking would be one of the largest, most time-consuming and costly of Derbyshire's sough projects, and was supported by a company of adventurers headed by Francis Edward Hurt.[15] The sough was begun in 1772, around the same time that Richard Arkwright first invested in the area, and was started 5 km down from the River Derwent. Arkwright anticipated early on that Meerbrook had the potential to eventually drain water to its level and compromise his own supply via the Cromford Sough. As a result, the Arkwright family, and specifically Richard Arkwright's son (also Richard), was in conflict with the Meerbrook Sough proprietors for much of the 67 years that it took to complete the driving of the sough, eventually culminating in a 1838–1839 court case.

The Creation of Vertical Territory: 1800–1813

In January 1807, the miners working on the new sough broke through into a vein that channelled a large amount of water into the sough and significantly lowered the water table in large parts of the Wirksworth mining field. The

flow was so powerful that it 'made a noise like the discharge of a cannon', and it filled the existing extent of the Meerbrook Sough with enough water such that the miners claimed that they 'went to our work generally in a boat and sometimes waded', with some stating that they 'were above our knees in water'.[16] Such evocative accounts point to the significance of the underground sensory experience of sough working and highlight the value of the local eye witness testimony that would prove central to later court cases (Garrett 2016, 2). More fundamentally, however, reaching this vein represented the start of the Meerbook Sough's drainage, which would ultimately lay dry the Cromford sough and so deprive Arkwright of the water power needed to run his textile mills. But Arkwright would not be the only hurdle encountered by Hurt and his fellow sough proprietors. The moment a sough reached the point at which it started to provide drainage was a precarious time, as its owners had to establish political and economic ownership of the new territory created by the unwatering by their sough.

As with the development of other underground water infrastructures (Garrett 2016, 5), the new territory opened up through sough driving was conceptual as well as physical. The vein which was breached which was subsequently symbolically named 'the Key to the Country' – a symbolic evocation of its unlocking of the underground space. Both the Cromford and the Meerbrook soughs were made visible through maps, plans and drawings, the *only* way to make the underground knowable for those who had not physically experienced it. This mapping, however, brought its own dilemmas, and indicates the limitations of the administrative surface world when it came to subterranean territory creation. Figure 2, for example, shows representations of Cromford Sough and the Gang Vein drawn as clean straight lines with clear boundaries of ownership. The map points to the progress made in the development of the Meerbrook Sough by 1798, indicated by the annotation 'Forefield of Mr Hurt's sough' written in the bottom right-hand corner of the map.[17] Significantly, maps such as these showed the soughs as if they were on a horizontal plane, without any indication of variations in topography and depth, thus obscuring the implications of the deeper sough on the vertical dimension of the hydrological landscape. The meers that denoted ownership of mines were set out at surface level, and mine maps and ownership deeds were concurrently designated from the surface as two-dimensional representations of subsurface space irrespective of subterranean complexities (Kirkham 1968, 38). Not surprisingly, therefore, the administrative world of companies, maps, deeds and courts often clashed with negotiations and developments of mines and soughs underground. Sough initiatives thus provided a forum where legal bureaucracy and geological complexity were brought together in an awkward interdependency.

In addition, the new territory became an economic space, with a vertical notion of finance that played an important role in the way sough drivers could claim subterranean power. While the very significant profits to be

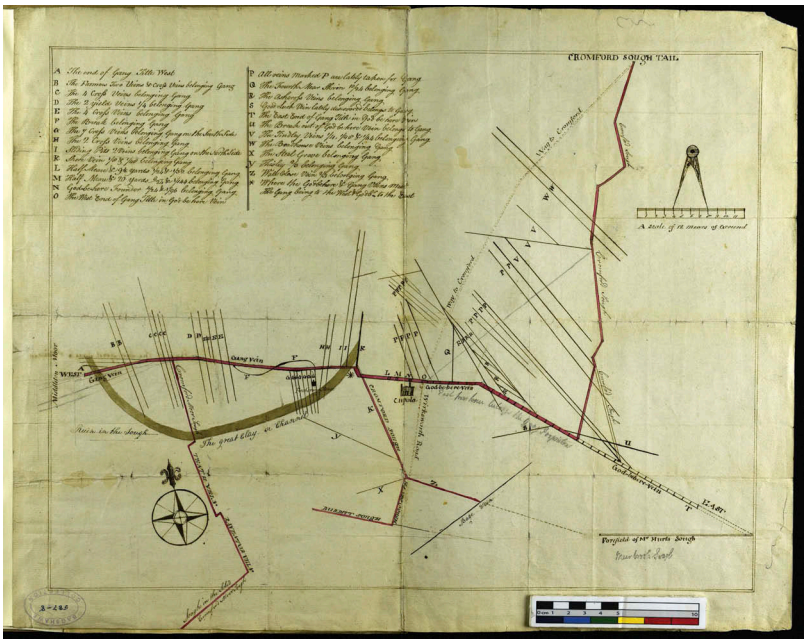

Figure 2. Underground sough map showing Gang vein, Godbehere vein and cross veins, and Cromford Sough in 1798. The start of Francis Hurt's Meerbrook Sough is illustrated in the bottom right hand corner with the annotation, "the forefield of Mr Hurt's Sough" (source: DRO D7676/ Bag C/587/8).

made from striking a rich lead vein was precisely what made the soughs politically and economically so important for the region, all soughs were 'expensive and risky investments' (Slack 2000, 43), involving very significant amounts of credit, over long periods of time, invested on the basis of speculative hope of mineral reward. This meant that the investors faced a considerable financial outlay up front and had to recoup that investment from the mines they drained once these mines were in production long after initial sough initiatives were first begun. Cutting through to the source that would start a sough's drainage was an important point in its life cycle. Often long-anticipated by miners and mine owners with an interest in the spaces that would be opened up by the lowering of the water table, it was also the first opportunity for the investors in the sough to receive any rewards from their investment, as sough projects often took decades until they reached the mines they intended to drain.[18] Indeed, so prolonged were the negotiations that the Arkwright-Meerbrook conflict was to involve two generations of both the Arkwrights and the Hurts.

Out of necessity, therefore, there was something of an 'anticipatory geo-politics' to sough endeavours fuelled by the length of time between the point at which sough driving was initiated and realisation of any profits from drained mines. The solution to the upfront, highly speculative financing of

soughs was an agreement referred to as 'composition' or 'compo' which was based on a vertical measurement of mine drainage. Before the sough reached the flooded mines, a 'watermark' was made at the pre-sough water level, and once drainage was achieved, a set proportion of ore found below this level could be claimed by the owners of the sough. However, the drained spaces beneath the watermark were often sites of contestation, particularly when multiple soughs drained the same area. Sough companies or groups of individuals who had provided capital to drive the sough regularly faced difficulties in retrieving pre-agreed composition payments of ore from mine owners. Moreover, on the part of the miners and mine owners, hopes were often pinned on continued support for, and investment in, the soughing venture, even though sough partnerships could at times be quite fragile and ephemeral. Disagreements between sough partners often stalled the funding and thus the progress of a sough, which could in turn affect the livelihoods of miners (and those involved in physically driving the soughs).[19]

The further driving of the Meerbrook Sough reveals this complexity of investment arrangements and the anxieties that underpinned them. As the sough edged towards the mines of the Cromford-Godber complex, difficulties in procuring composition agreements with the mines became evident. The mines already had composition agreements with the Cromford Sough, which drained them to a certain level, and as this sough was at this time owned by the same people who owned the Dovegang Mines, they were reluctant to confer their compo agreements to the Meerbrook Sough. The double investment in mines and the soughs draining them was common and formed a protection from both the long periods between investment and production in sough driving as well as from the compo payments, which could be substantial, and which in this case would be paid to the investors themselves. Paying composition to the adventurers of the Meerbrook Sough would mean that the Cromford Sough owners only stood to profit from the mines, while their own sough was made redundant. At the same time, however, this hampered their own enterprise – the Dovegang mines – which were not being worked while the dispute ran on.

Violent Landscapes, Volatile Flows: 1807–1836

As the driving of Meerbrook Sough ground to a halt, and the mines stood idle while negotiations were at a stalemate, the impact of the lack of mine drainage underground was felt throughout the region. In an exercise that might be considered to be a subtle, but necessary, perhaps desperate subversion, a group of 'Miners of the Soak and Wapentake of Wirksworth' wrote a 'humble petition' to beg the owners of both soughs to sort out their differences 'for the sake of alleviating the distresses of society' and the 'sanguine wishes for the lower ranks of us to meet with employ',[20] showing the urgent need for mine drainage and the importance of soughing in supporting the livelihoods of people in the

region. The Meerbrook owners eventually continued work at their sough, despite the lack of compo agreement and the significant financial risk this entailed. In order to protect their precarious position, however, they utilised the physical volatility of water as a tool to strengthen their negotiating position. By constructing wooden doors or 'floodgates' in the forefield that connected with the 'Key of the Country', the Meerbrook Sough owners were able to flood the mines again in order to force or 'compel payment of composition by Mines, particularly the Gang Mine'.[21] This forcing of compo was a common strategy adopted in other sough endeavours throughout the history of sough driving in Derbyshire.[22] Ongoing mining work further down the sough meant that the Meerbrook's gates could not be closed until 1812, though first-hand testimonies reveal the impacts of their closure when it did happen.[23] George Hardy, a miner working in the Gang mine at the time, testified that the closure of the doors 'cause[d] a considerable quantity of water to flow into the lower levels of the mine'.[24] However, throwing the water back into the Gang mines had some unexpected consequences. The Gang miners had been using a waterwheel to drain the lower levels of their mine and found that they were now able to use the extra water to turn this wheel much faster and pump the water that drowned their lower levels up into the Cromford Sough.[25] As a result, rather than impeding access to the veins, and thus forcing composition payments, the 'injury that was caused by the water being increased in the lower levels was remedied by the increased power being given to the wheels'.[26] Moreover, this move meant that Arkwright retained his Cromford Sough water supply.

The mutually beneficial situation above and below the ground led, in November 1813, to the owners of both soughs agreeing that the Meerbrook soughers would leave their floodgates in place to throw water onto the wheels, while the sough continued as a cross-cut towards the eastern end of the Godber, and would receive composition for the drainage this provided. While one-twelfth of all ore found below the watermark was a lot lower than the Meerbrook Sough Company had initially demanded (between one-sixth and one-ninth), there was at least an agreement, with all groups having some security in their physical and financial underground claims.[27] Mines, however, are working environments with a dynamic frontier, and it was not long before the topographical and hydrological situation changed again. In 1815, a channel cut across from the Meerbrook Sough connected to the Gang mines, and soon water was redirected through its outlet rather than the Cromford Sough.[28]

Oral testimony once again reveals the implications of this action. According to Thomas Brooks and John Oxspring, two miners who had been present in the Meerbrook Sough at the time, 'The quantity of water that came down was very large', and it 'must have caused a considerable diminution from the Cromford Sough' as a result.[29] This in turn left Arkwright's mills at Cromford with a much diminished supply to turn his mills, and in September 1815, Richard Arkwright Jr wrote to the Cromford

Sough owners to claim his water back. In as much, the vertical and the horizontal were 'mutually implicated' (Harris 2015, 602).

The conflict as it then played out focused on rights over water and tensions between the horizontal and volumetric understanding of resource ownership and access. It also reflected changing regulations regarding upstream and downstream water users as the use of water for power intensified during the Industrial Revolution. Flowing water became an increasingly contested resource, accompanied by complex litigation and a shift in common law towards the notion that water rights could be appropriated through usage, a tactic Arkwright's lawyers attempted to exploit (Getzler 2004). In this instance, however, these new interpretations over the ownership of a moving, flowing good clashed with the local 'mineral laws' under which the Derbyshire miners operated. During the various stages of out-of-court negotiations as well as the eventual court case, the different conceptualisations and formulations of ownership and territory collided. As Richard Arkwright Jr wrote to the Cromford Sough owners to claim his diverted water back, their advisor and fellow shareholder, Henry Dickinson, replied that Arkwright would have to prove his rights over the water issuing from Cromford Sough. While there was no objection to Arkwright's use of this water while it effectively ran to 'waste', Dickinson claimed that according to mineral custom, miners and mine companies were not obliged to force water in any particular direction unless there was a risk that the displaced water could flood another set of mine works.[30]

In response, Arkwright turned his attention to the Meerbrook Sough, the underlying cause of his water being abstracted. He was confronted with Hurt insisting that the Meerbrook Sough was being driven well within long-established mineral laws of underground ownership. While no agreement could be reached about the ownership of flowing water, there was a mutual economic interest in the space opened up through the Meerbrook Sough's drainage. The nineteenth century was the tail end of Derbyshire lead mining and the livelihood of many, including the miners and the sough investors, depended on the further vertical expansion of the mining area. As the lessee of all the mineral duties payable to the Crown in the Wirksworth Wapentake, Richard Arkwright Jr. had a particular financial interest in this space: he received the 'lot' and 'cope' payable under the free mining laws, and the amount of these duties depended on the amount of ore found.[31]

The agreement Arkwright and the owners of both soughs finally reached in early 1821 was grounded in the shared economic interest in the underground space drained by the Meerbrook Sough and the explicit acknowledgement that it was 'greatly to the advantage of all and every of the several parties' that the Godber mine was worked.[32] In addition, the construction of a set of doors with valves that could be opened or closed to channel the water down Meerbrook Sough or throw it back towards the Gang veins to turn their waterwheel helped to resolve the conflict with Arkwright, since it meant

that most of the time, water power in the Cromford Sough was actually stronger than it had been before.[33]

Once again, the complicated hydropolitics associated with sough driving co-evolved through the intersection of economic and political interests above-ground, the changing nature of the underground water infrastructure and the flow or stoppage of water thereby. Nevertheless, once the lucrative ore-bearing parts of the underground space opened up through the Meerbrook Sough's drainage had been worked out down to the new water table, this 'new' space lost its financial attraction and was considered economically dead. In 1836, the owners of the Meerbrook Sough decided to resume the original course towards the south-west to pursue the drainage of a new part of ground, and they notified Arkwright that they were planning on removing the gates completely.[34] With all mediation over, Richard Arkwright took the Meerbrook Sough owners to court where different notions of space, water rights and territory clashed and were tested by law – the subject of the next section.

The Court Case: Subterranean Spaces and Voices from the Past, 1838–1839

Both Richard Arkwright and his son had been steadily expanding their ownership over the land through which the Cromford Sough ran over many years. By the time of the 1838 court case, Arkwright Jr had even acquired a share in the sough itself[35] and claimed 'an absolute right to the water' based on his family's active usage for over 40 years. He also claimed rights to the water issuing from Cromford Sough based on his ownership of the surface land through which the water ran. His claims were thus based on a conceptualisation of ownership of *surface* land and water through time, whereas the sough conflict, throughout its various iterations, had always essentially been a volumetric conflict, necessitating a multidimensional consideration of the space underneath Cromford Moor. This was, therefore, a struggle over competing territorial imaginaries.

Arkwright's tactic in the court case can be contrasted with the view of the Wirksworth miners introduced before. Their humble petition to the owners of Cromford and Meerbrook soughs proposed a solution to the conflict – splitting the area across various planes, both horizontally as well as vertically and assigning potential composition from different sections to either sough.[36] Their knowledge of this underground space and how it would be affected by the Meerbrook's drainage allowed them to suggest this stratigraphic intervention and to look through this landscape and anticipate future changes in flows through this contested space. Here was a group of people whose experience and knowledge of the underground rendered them legal pawns in highly contentious and political cases. Crucially, the perception of the miners in this case is neither solely vertical nor horizontal but offers a

volumetric concept of territory and recognised the soughers' efforts in opening up this space, and their needs for compensation.

Soughs were developed largely due to 'the relationship between a powerful above and less powerful below' but this 'did not always map in this straightforward fashion'. The essential geophysical elements of the dispute occurred in a place which was hidden from the jurors as well as from some of the parties involved. There was a regime of visibility and invisibility which gave strategic influence to those with first-hand testimony of the underground and power to those who had access to and could deploy this information. There were many possibilities for deceit and deception, and difficulties in terms of proving provenance of ore brought to the surface. In as much, the 'hidden' nature of underground lead mining spaces exacerbated surface-level legal negotiations over access and ownership, as owners and investors had to trust the miners' word that ore hauled up from a shaft originated from a particular part of the mine. Lead mining was thus essentially a three-dimensional process, albeit one hidden from the surface, and the lead mining landscapes were spaces where power and politics were interwoven, both above and below ground.

Indeed, as underground access to these spaces was closely guarded, interested parties at the surface – even some of those involved in these major investments – necessarily had to rely on knowledge from miners who could testify to the situation underground. Their detailed understanding of and verbal testimony on the underground in fact became central to making 'visible' these otherwise hidden, subterranean spaces as well as the flows that affected the surface. Oral testimony had clearly long played an important role in mine-related conflict resolution through the Barmoot Court, but oral history was to be absolutely pivotal to the next stage in the Arkwright – Hurt dispute, which would add new alternative 'experiences, practices and textures' to the legal complexity of the dispute. Jonathan Elliott, for instance, aged 73 when he gave evidence in 1838, was called upon to illustrate the effects of sough drainage on the mines. He had been working at the nearby Bage Mine at the time of the Meerbrook Sough reaching the 'Key of the Country' in 1807, when he was asked to go down the mine to observe the effects of the sough opening up underground space: 'from the time the water was tapped in the sough to the time I left the mine the water had dropt 2 ft. The next day I went down again and found the water had fallen 2 ft 6 more'.[37]

Many, if not most, of the miners were illiterate and could not sign but 'marked' their testimonies, while some of those giving evidence on the appearance of mines and soughs in the early days of Arkwright's involvement in the area were in their late seventies and early eighties by 1830s. Yet their memories provided vital detail. William Weston, for instance, who was aged 82 at the time of the court case, was one of the few people alive who could recall the outflow of the sough before any of the Arkwrights' alterations. As 'a little boy being in the habit of going to wade or bathe up the Cromford

Sough (…) The water could not be deep. We had our breeches off. I should say 2 feet in depth was the outside (…) The Stream of Water which now flows down the Cromford Sough is much more than what it was when I first remembered the Sough, should think double'.[38]

The overseers who had been in charge of some of the crucial decisions were no longer alive, and it was up to the miners who had worked with them to interpret why a certain alteration in the course of a sough had been made, as was the case in the testimonials of working miners regarding what they had been told with respect to their reasoning for closing the original gate.[39] None of those giving evidence could provide the whole story, or even an overview of the full situation. Many could only testify in terms of part of the mine, sough or shaft that they had been working on. Together, however, this body of miners' testimonials and the work of the sough company's lawyers in collating the sough's narrative allow the reconstruction of a complex multi-dimensional landscape in which flows are directed and redirected as circumstances changed, and in the absence of other means of modelling the machinations of sough drainage, the oral evidence of the miners exhumed the otherwise hidden part of the sough dispute for the benefit of the court. Their testimonies and oral histories, therefore, allow us to examine the complex social and political dimensions of sough space and create something of 'an extended observation of the social dynamics' of vertical sough spaces (Harris 2015, 601).

The case was ultimately settled in favour of the Hurt's Meerbrook Sough Company, with the final verdict emphasising the 'temporary character' of the water in the sough, as it was only there as a result of the mine owners' wishes to get rid of a nuisance in their mines. The water had not been brought there for Arkwright's purpose or benefit per se, and as a result he could confer no rights from having used it for decades.[40] The verdict acknowledged the changeable nature of the mining spaces, as the court had pieced together the catalogue of alterations through the testimony of those who had created them, and the constant changes in underground infrastructure and water flows that were occasioned by the area's sough drainage through time. The damage to Arkwright was irretrievable: the upper and lower mills at Cromford ceased production only a few years later and so came to a close one of the most industrious but litigious eras in the history of Derbyshire's Derwent Valley (Buxton and Charlton 2013; Cooper 1983, 78).

Conclusion: Temporalities and Territories, Volatility and Flow

As Elden (2013, 35) has noted, 'Territory is not merely a cognate of land, a political-economic term implying ownership, exchange and use value, distribution, partition, division'. There is also more than 'a strategic, political dimension to the term, understanding the power relations in a narrow sense of contestation

and struggle … Rather, 'power' should be understood … as including, among other aspects, the legal and the technical'. This paper has investigated legal disputes associated with lead mining soughs, driven to unwater important lead veins in the Wirksworth-Cromford area of Derbyshire and has sought to demonstrate how broader legal and technical conceptualisations of both territory and power can be applied to the underground landscape, so extending concepts of vertical, volumetric and stratified territories.

Technologically innovative, bureaucratically complex, soughs effectively allowed for the exploitation of lead ore deep below the ground and thus the creation of economically viable and potentially very lucrative territory. Yet the productive territories drained and made accessible by soughs were temporary and volatile, posed environmental, logistical, practical and legal challenges and soughs themselves were implicated in a protracted socio-physical legal process which effectively connected the underground with the surface landscape. The driving and sinking of the soughs far below the surface, for example, and the manipulation and modification of both surface and subsurface water flows contributed to myriad legal disputes between all cross-sections of society.

As David Blackbourne notes, 'With mastery of the water comes the opportunity for conflict over it', as is seen in recent historical and contemporary conflicts over water (Blackbourne 2006, 7; Gelvin 2014). There were 'rupture points' when underground waterways were made and remade 'to serve new interests' (Blackbourne 2006, 7), setting rival industrial interests against each other. Indeed, conflict was also associated with the long-term nature of sough projects. Soughs were risky and expensive investments and were often supported, developed and driven on the basis of what could be seen as quite precarious legal arrangements over composition. Disputes over these arrangements were common between local or small-scale claims and larger interests (Swyngedouw 2004). The contestations that resulted engaged with a much broader suite of issues concerned with water use, management, sharing, access, deprivation and inundation, and reveal how land-water-culture relationships were negotiated and challenged, but in tandem underground as well as above and over time. Furthermore, a range of human and non-human issues were mobilised in these disputes, from water provision and deprivation through to social welfare and local and regional economic well-being. In as much, we might consider soughs to be artificial constructions through which socio-environmental or techno-natural relationships and problems were produced, negotiated and contested and an uneasy geopolitics developed between legal bureaucracy above ground clashed with geological complexity below.

Investigation of the narratives surrounding the history and life course of the two soughs considered in this study – the Cromford and the Meerbrook Soughs – brings into relief the complexity and multidimensional nature of

legal sough negotiations – what we might term 'elemental geopolitics' – involving miners, investors and industrialists, including some of the most powerful industrialists of the period. The soughs in question served a key function in the refashioning of subterranean and surface hydrological landscapes. They drastically modified subsurface and surface water flows, and simultaneously contributed to a reconfiguration in social and power relations both above and below ground. The volatility of watery flows below ground was mirrored by an equally volatile economic, cultural and political context above ground where rival, powerful interests were pitted against each other. In as much as they played a role in opening up new economically fruitful territory underground, for example, the sough infrastructures were also used to close territories off and represented technological and legal 'tools' which were manipulated in this respect.

Importantly, the cases discussed in this paper, as with other documented sough disputes, were reliant on eye witness testimony and oral tradition provided by the miners who had worked underground. The transcripts of these testimonies provide important information on the construction of the soughs, the reasons behind physical alterations underground as well as their effects on subterranean and surface water flows. It is clear that the views and the voices of the underground miners provided a very powerful tool in these vertically oriented negotiations by making 'visible' the otherwise hidden geographies of the subterranean landscape which were so central to the sough negotiations. Surfacing the voices of those involved in the construction of complex sough infrastructure underground, however, together with those of the people who were affected by sough drainage above and below the surface, and investigating the complex legal wrangling that ensued as a consequence, provides ethnographic and elemental 'texture' to the verticality of mining lives and landscapes (Harris 2015).

From the perspective of verticality, we can consider soughs to be 'umbilical cords' between surface and subterranean spheres (Bridge 2013, 55), representing vital connections between the visible surface landscapes, hydrology and legal and political discourses and the mineral resources, infrastructure and associated flows of the underground realm. Analysis of the implications of the two soughs enables us, and in fact requires us, to think beyond surface geographies (Tolia Kelly 2013), to think vertically through landscapes rather than across them, but also affords insight into the volumetric nature of these underground spaces through which water flowed.

Moreover, the drawn-out nature of these and other sough projects, the sheer length of time that it took to drive a sough and unwater mines and the lengthy legal machinations that could accompany these endeavours, which as illustrated spanned generations, highlight the importance of thinking about temporal as well as vertical depth. The case study not only provides an opportunity to rescue soughs from their 'ubiquitous obscurity', hidden

from the surface while extending laterally and vertically below ground, but also allows for a reframing of subterranean space from being 'less out of sight, off limits and atemporal' to being more visible, accessible and very much linked to a range of temporalities (Garrett 2016, 1). A more sustained study of soughs and their legal implications could further help define this reframing as well as providing a means of extending the so-called 'vertical turn' in geopolitics and human geography to historical industrial subterranean landscapes.

Notes

1. Soughs and adits – horizontal passage leading into a mine for the purposes of access or drainage – were also used in the coal industry prior to the advent of the steam engine.
2. The multiple papers published in *Mining History: Bulletin of the Peak District Mines Historical Society*.
3. The Crown retained its universal right to mineral duties or 'lot' or every thirteenth dish of lead ore mined and 'cope' on every load bought. The miners also paid tithes on every tenth dish to the Church (Slack 2000).
4. William Blackstone's *Commentaries on the Laws of England* notes that 'Land hath also, in its legal signification, an indefinite extent, upwards as well as downwards … "land" includes not only the face of the earth, but everything under it, or over it' (Vol II, 1766, 18). The mineral laws, however, created a split estate as opposed to a Blackstonian volumetric conceptualisation of land ownership in which a claim to land extends downwards (Prest 2016).
5. This sough may have been predated by Fleetwood's Drain (possibly in Dovedale), Weet Sough in Winster, Bartholomew's Sough and possibly also the Swallow Drift at Tearsall Groves, Wensley. See Rieuwerts (1984).
6. The mineral customs were put into verse by Edward Manlove, *The liberties and customs of the lead mines*, edited by T. Tapping, 1851. The original version was first published in 1653. Manlove was a Barmoot Court Steward.
7. A range of primarily legal materials were consulted in the Derbyshire Records Office (hereafter DRO), Chatsworth House, Barmasters Collections, The Wolley Manuscripts collections at the British Library and the various lead-related materials now held in the Sheffield Archives and Local Studies library.
8. The lead field in Cromford and Wirksworth was especially rich. The Dovegang Rake or Gang Rake was an extensive field, running for more than 600 yards, from near Black Rocks, between Cromford and Wirksworth, across Cromford Moor to Middleton. With its tributary veins, it covered an area of about 200 acres (Slack 2000, 29). It is thought to have been mined from around the fourteenth century, but evidence indicates that miners had reached flooded veins from about 1597. Most documents dealing with early drainage confirm that the absolute limit of working was 240 feet below the surface (Rieuwerts 2007, 23).
9. On 1 August 1771, together with his partners and financiers John Smalley, Samuel Need, Jedidiah Strutt and David Thornley, he leased 'all that river stream or brook, called Bonsall Brook (…) together with the stream of water issuing and running from Cromford Sough in Cromford aforesaid into the said Bonsall Brook with full liberty and power to divert, turn and carry the said brook, stream and water (…)'. Draft of legal case involving Richard Arkwright, 1775, Chatsworth Archives Barmasters Collection, 89/12.

10. Draft of legal case involving Richard Arkwright, 1775, Chatsworth Archives Barmasters Collection, 89/12.
11. Agreement between Richard Arkwright and the owners of the Cromford Sough, 3 June 1785, DRO D7676/Bag C/750.
12. John Balguy, verdict on arbitration, 14 October 1785, DRO D7676/Bag C/751.
13. Copy of agreement between the Cromford and the Meerbrook sough proprietors, 1825, DRO D267/53/22.
14. Deposition by William Frost in Arkwright vs Gell papers, 1838, DRO D3029/J .
15. While the Meerbook Sough started providing mine drainage from the early nineteenth century, it was not completed until 1845, by which time the Derbyshire lead industry was on the wane (Ford and Rieuwerts 2000).
16. Depositions by John Oxspring, George Land and Thomas Brooks in Arkwright vs Gell papers, 1838, DRO D3029/J.
17. This map was created at a time when the sough was close to breaking through to the veins and 'unwatering' the area, leading to long and protracted negotiations between the different factions of miners and sough owners about who would have rights over the ore that would be laid dry by this drainage.
18. Advancing one mile in ten years was considered to be optimistic (Willies 1986, 263).
19. A case in point where agreements between sough partners foundered focuses on the Baileycroft Sough (see Slack 2000).
20. Petition of the Miners of Wirksworth, 1799, D7676/BagC/587/10.
21. Deposition of William Wheatcroft in Arkwright vs Gell papers, 1838, DRO D3029/J.
22. The owners of the Stoke Sough (near Calver in Derbyshire), for example, had issued orders to completely block their sough to try to compel payments in the early eighteenth century, while the Dovegang Company itself had blocked the Hannage Sough (which they also owned) to secure payments from the Northcliffe mines (Flindall 1982; Rieuwerts 1994).
23. The first doors failed as a result of water and air flows and burst open. New doors were constructed which did hold the water back and they remained closed for about 12 months, while a new shaft was constructed to facilitate air flow at the forefield. For 3 or 4 years after this, they drove the sough westward and northward (cutting Sheldon, Spencer and Brookes veins). During this time, the water flowed through the doors down the Meerbrook Sough, draining the Gang mines. Depositions of Thomas Brooks and John Oxspring in Arkwright vs Gell, 1838, DRO D3029/J. Deposition of William Wheatcroft, Arkwright vs Gell papers, 1838, DRO D3029/J.
24. Deposition of George Hardy in Arkwright vs Gell papers, 1838, DRO D3029/J.
25. Deposition of George Hardy and William Sims in Arkwright vs Gell papers, 1838, DRO D3029/J.
26. Deposition of George Hardy, Arkwright vs Gell papers, 1838, DRO D3029/J.
27. Copy of composition agreement between the Cromford Sough and Meerbrook Sough Proprietors, 1817, Sheffield Archives BGM/110; also a copy in Chatsworth Barmaster collection, 89/14.
28. This seems to have been a decision made by the Gang miners, as when the cross-cut broke through to the Gang vein the water was not automatically drained, but actively redirected. Deposition of Job Spencer in Arkwright vs Gell papers, 1838, DRO D3029/J. This might have been an easier route than lifting it to the Cromford level as it was lower.
29. Depositions of Thomas Brooks and John Oxspring, Arkwright vs Gell papers, 1838, DRO D3029/J.
30. Letter from H Dickinson at East India Buildings London 14 September 1815, in Arkwright vs Gell papers, 1838, DRO D3029/J.

31. Copy of agreement DRO D267/53/22.
32. Copy of agreement, DRO D267/53/22.
33. Deposition of James Mather in Arkwright vs Gell papers, 1838, DRO D3029/J.
34. Deposition of Joseph Flint in Arkwright vs Gell papers, 1838, DRO D3029/J. They did remove the gates but put them back up to await the outcome of the case.
35. Arkwright vs Gell papers, 1839, DRO D3029/J, 211.
36. Petition of the Miners of Wirksworth, 1799, D7676/BagC/587/10.
37. Deposition by Jonathan Elliott in Arkwright vs Gell papers, 1838, DRO D3029/J.
38. Deposition by William Weston in Arkwright vs Gell papers, 1838, DRO D3029/J.
39. Depositions of Thomas Brooks and William Wheatcroft in Arkwright vs Gell papers, 1838, DRO D3029/J.
40. Arkwright vs Gell papers, 1839, DRO D3029/J, 215.

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